Part II: HSI Methods in system development

Frank Ritter, without help from Barry Boehm this time

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Glossary

• EDA  Event Data Analysis
• FMEA Failure modes and effects analyses
• SA  Situation Awareness
• WoO Wizard of Oz
• WoO² WoO squared
The Incremental Commitment Life Cycle Process: Overview

**Stage I: Definition**
- **General/DoD Milestones**
  - Initial scoping
  - Concept definition investment analysis
  - System architecting
  - Increment 1 development
  - Increment 1 operations
  - Increment 2 architecting rebaseline
  - Increment 2 development
  - Increment 3 architecting rebaseline
- **Exploration Commitment Review (ECR)**
- **Valuation Commitment Review (VCR/CD)**
- **Architecture Commitment Review (ACR/A)**
- **Development Commitment Review (DCR/B)**
- **Operations Commitment Review (OCR/C)**

**Stage II: Development and Operations**
- **Operations Commitment Review (OCR/C)**
- **Development Commitment Review (DCR/B)**
- **Architecture Commitment Review (ACR/A)**
- **Valuation Commitment Review (VCR/CD)**
- **Exploration Commitment Review (ECR)**

**ICM Lifecycle Phases**
- **Exploration**
- **Valuation**
- **Architecture**
- **Development**
- **Operations**

**Activities**

- Concurrent risk-and-opportunity-driven growth of system understanding and definition
- Evaluation of evidence of feasibility to proceed
- Stakeholder review and commitment

**Anchor Point Milestones**

**Synchronize, stabilize concurrency via FRs**

**Risk patterns determine life cycle process**

Adjust scope, priorities, or discontinue
The Risk Management Process

- Good practices for program management
  - Assumes a stakeholder analysis (e.g., business offer, proposal, specification)
  - Including HSI in this process
  - A program organization
  - Culture of openness

Human-system Integration is an integral thread throughout process management & execution
The Risk Management Process: Handling Options

Comments:
• Dealing with large risks
• HSI has a set of tools for these options, more for avoid (know user and task) Assume (monitor), Mitigate (understand, modify)
• Ritter’s impression is that in normal progress, risk sizes decrease over time

1. Undertake for significant risks only
2. Consider the following options in descending order:
   ➢ Avoid the risk (e.g., delete a requirement)
   ➢ Transfer the risk (e.g., reallocate a requirement)
   ➢ Assume the risk (e.g., monitor & reassess)
   ➢ Mitigate the risk (e.g., risk mitigation plan with fallback options)
Methods

• Three major periods of use
  – Define context of use
  – Define requirements and design solutions
  – Evaluate

• All fit back into spiral, all used to reduce risks using previous approaches
• We have bags of these methods!
• Classification to period is somewhat arbitrary
• Not exhaustive, *illustrative*
• Function allocation not covered
• Performance measurement details not covered
Some Assumptions of the Report

• Technology advanced enough to support users
• Risks shift[ing] to user interaction and not technology
• Environments are changing, so designing based on old assumptions more risky than previously
Area 1: Context of Use

- Helps avoid local optimizations, feature creep, unanticipated effects
Organizational and Environmental Context

- Overview
- Shared representations
- Use
- Contributions
- Strengths, limitations, and gaps

<table>
<thead>
<tr>
<th>General Method</th>
<th>Source of Data (input)</th>
<th>Shared Representation (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational system scan</td>
<td>Authority and communication analysis&lt;br&gt;Mission, vision, principle analysis&lt;br&gt;Input/output analysis</td>
<td>Organization charts&lt;br&gt;Table of gaps (variances)&lt;br&gt;Input/output system model</td>
</tr>
<tr>
<td>Role analysis</td>
<td>Gap-focused survey, focus groups, and/or interviews</td>
<td>Role network</td>
</tr>
<tr>
<td>Cultural analysis</td>
<td>Culture survey</td>
<td>Cultural profile</td>
</tr>
<tr>
<td>Stakeholder analysis</td>
<td>Gap-focused survey, focus groups, and/or interviews</td>
<td>Futures table</td>
</tr>
</tbody>
</table>
Notes on context of use

• Gaps of perception
  – So: communication and perception count
  – Communication interfaces need to be developed

• A problem remains: How big is a context? Where does it stop?
Field Observations and Ethnomethodology

• Both holistic, and solely descriptive and generalizable
• Helps system designers understand the context of use, perhaps for the first time
• Hallmark is its ability to change focus and direction when faced with new insights
• Privileges users as a stakeholders
• But needs to change to teach system designers - Ritter
• To have more impact and to be fair, needs to similarly privilege users of information - designers - Ritter
Task Analysis

• Can reuse previous methodology
• Focuses on the shared representation
• May be seen as that - Ritter
• Seen as too hard by some designers (?)
• Can be done in a ‘grounded’ way
• Can draw on many other methodologies
• Can be reused in many places
• Is not always reused at all
• Insight: Impact on next project
  – Size of users tasks, complexity of tasks, their interrelation, scope
  – May be true for all these methods
  – So shared to next design, and understanding of designer
Participatory Analysis

• Insight: Can be combined with many other methods
• Getting users involved in the process
• Communication can be difficult, but rewarding
• Push back from designers is not understanding their risks as designer and implementers - Ritter
Event Data Analysis

- All kinds of data
- Looking for patterns
- Relies on shared representations

FIGURE 6-7 Example of a Pathfinder network (r = infinite; q = 9) based on conditional transition probabilities between events. Bold numbers on nodes indicate event frequencies. Numbers on links indicate transition probabilities between the two events (adapted from Cooke, Neville, and Rowe, 1996).
<table>
<thead>
<tr>
<th>Question</th>
<th>Type of Event Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>What does the operator do from moment to moment? What options are not used? What options precede the request for help? What action sequences occur often enough to be automated or assisted?</td>
<td>Keystrokes, mouse movements, click streams.</td>
</tr>
<tr>
<td>What are the service demands made on a shared resource (like a server or a database)? What are critical dates or times of day? How can server/database traffic be anticipated or smoothed?</td>
<td>Hits on a web site. Database accesses. Server traffic. (While conventional server logs provide a very low-level view of these demands, instrumentation can provide a work-oriented account of server demands.)</td>
</tr>
<tr>
<td>What are the current issues that the organization is grappling with? What is the organization’s current intellectual capital?</td>
<td>User-initiated social-software events and data, like tag creation and tag modification, blog entries, wiki entries, and current searches.</td>
</tr>
<tr>
<td>What are people thinking and planning as they work? What confuses them?</td>
<td>Think-aloud reports. Verbal reports. Paired-user testing.</td>
</tr>
<tr>
<td>What is the communication network in the organization? Who communicates with whom?</td>
<td>Communications events (email, chat, meeting attendance).</td>
</tr>
<tr>
<td>What is the context of critical events? How often do critical events occur and what events preceded and follow them?</td>
<td>Stream of video events (e.g., in an emergency room or air traffic control center). One or more recordings of shared radio frequencies.</td>
</tr>
</tbody>
</table>
TABLE 6-5 Life-Cycle Phases of the ICM and EDA

<table>
<thead>
<tr>
<th>Phase</th>
<th>Method</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration</td>
<td>EDA</td>
<td>May help scope problem; can base on expert judgment if no existing system.</td>
</tr>
<tr>
<td>Valuation</td>
<td>EDA</td>
<td>Use to describe existing behavior; highlight obvious weaknesses, strengths.</td>
</tr>
<tr>
<td>Architecting</td>
<td>EDA</td>
<td>Begin to focus more on future behavioral repertoire; change to existing behavior patterns.</td>
</tr>
<tr>
<td>Development</td>
<td>EDA-E</td>
<td>Can collect behavioral data with prototype and evaluate success of new design.</td>
</tr>
<tr>
<td>Operation</td>
<td>EDA-E</td>
<td>Given other criterion can collect data from users in beta testing to assess success.</td>
</tr>
</tbody>
</table>

NOTE: EDA-E (Evaluative) includes evaluative steps such as assessment and diagnosis.
EDA notes

• Plenty of resources, tools, methods
• Ties to TA, other approaches
• Selection of data & analyses
• Problems
  – Can focus on wrong measures
  – Will always work
  – Requires prototype
Area 2: Defining Requirements and Design

<table>
<thead>
<tr>
<th>Context of use constraints</th>
<th>Quality in use requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product requirements</strong></td>
<td><strong>Usability requirements</strong></td>
</tr>
<tr>
<td><strong>Inherent property requirements</strong></td>
<td><strong>Quality requirements</strong></td>
</tr>
<tr>
<td><strong>Functional requirements</strong></td>
<td><strong>Other quality requirements</strong></td>
</tr>
<tr>
<td><strong>Assigned property requirements</strong></td>
<td>Managerial requirements including, for example, requirements for price, delivery date, product future, and product supplier</td>
</tr>
<tr>
<td><strong>Development process requirements</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Development organization requirements</strong></td>
<td></td>
</tr>
<tr>
<td><strong>For example, requirements for data and business processes</strong></td>
<td></td>
</tr>
</tbody>
</table>

FIGURE 7-2 Classification of requirements.
Stretch of these tools

<table>
<thead>
<tr>
<th>HSI Activities</th>
<th>Defining Opportunities and Context of Use</th>
<th>Defining Requirements and Design</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who's involved?</td>
<td></td>
<td>Domain practitioners</td>
<td></td>
</tr>
<tr>
<td>Design experts and other stakeholders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Representative set of methods</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Usability Requirements</td>
<td>- Work Domain Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Workload Assessment</td>
<td>- Participatory Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Contextual Design</td>
<td>- Physical Ergonomics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Situation Awareness</td>
<td>- Methods for Mitigating Fatigue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Prototyping</td>
<td>- Scenarios</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Personas</td>
<td>- Models and Simulation</td>
<td></td>
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</tr>
</tbody>
</table>
Usability requirements

• Usability is not likability (seen in Rossen and Carroll chapter)
• Hard to know if systems will meet these measures
• Don’t have good measures and standards
• Optimizes what is measured
Situation Awareness

• Does the mental model match the world?
• Useful for system designers to keep in mind!
Personas

• Designed to be a shared representation of users
• Role or segment archetypes
• Particularly when designers are not like the users
• See Ritter, Freed, Hasket for a weak example
Models

• Risk: we are not like we think we are
• Running models in our head is hard
• But models hard to use
• But but working on models to be more usable
• Insight: perhaps especially here, designers learn for the next design
Area 3: Methods for Evaluation

• Also see all previous methods
Failure modes and effects analyses (FMEA)

- Identify risks, etc.
- Recursive of risk analysis to end user use
- Tools make easier (and perhaps more fun, and perhaps sharable)
Types of Human Errors

- **Basic error types**
  - slip

- **Attentional failures**
  - intrusion
  - omission
  - reversal
  - misordering
  - mistiming

- **Memory failures**
  - omitting planned items
  - place-losing
  - forgetting intentions

- **Rule-based mistakes**
  - misapplication of good rule
  - application of bad rule
  - Knowledge-based mistakes
  - many variable forms

- **Routine violations**
  - Exceptional violations
  - Acts of sabotage
Usability Analysis

- Uses performance measures, experimental design, psychology, physiology, ergonomic sciences